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## CALCULUS.

172. Proposed by F. P. MATZ, Sc. D., Ph. D., Professor of Mathematics and Astronomy in Defiance College, Defiance, O.

$$\text{Solve } x \frac{dy}{dx} = \frac{y}{y^{-1} - \log x}.$$

Solution by W. W. BEMAN, A. M., Professor of Mathematics at the University of Michigan, Ann Arbor, Mich.

Writing the equation in the form  $y \frac{dx}{x} + \log x \, dy = \frac{dy}{y}$ , we get  $y \log x = \log cy$ ,  
or,  $x^y = cy$ .

Also solved by G. W. Droke, Fayetteville, Ark.; M. E. Graber, A. B., Instructor in Mathematics and Physics, Heidelberg University, Tiffin, O.; O. W. Anthony, DeWitt Clinton High School, New York City; G. W. Greenwood, B. A. (Oxon), Professor of Mathematics and Astronomy, McKendree College, Lebanon, Ill.; G. B. M. Zerr, A. M., Ph. D., Parsons, W. Va.

## MECHANICS.

161. Proposed by W. J. GREENSTREET, A. M., Editor of The Mathematical Gazette, Stroud, England.

Four equal uniform smoothly jointed rods length  $a$ , and width  $w$ , form a rhombus  $ABCD$ ,  $A$  and  $C$  being in contact with two vertical walls  $b$  feet apart. An elastic string, natural length  $x$ , modulus  $\lambda$ , keeps the figure in position. The angle of friction at  $A$  and  $C$  is  $\tan^{-1}p$ . When the rhombus is just about to slip, find the angle  $A$ , and the angle between  $AB$  and the vertical.

Solution by G. B. M. ZERR, A. M., Ph. D., Parsons, W. Va.

Suppose the rhombus to be held in form by two strings  $AC$ ,  $BD$  in a state of tension and that the rhombus is in a plane perpendicular to the walls. Let  $T$ ,  $T'$  be the tensions in  $BD$ ,  $AC$ ; then the virtual work  $T' \cdot \delta AC + T \cdot \delta BD = 0$ .

$$\text{But } AC^2 + BD^2 = 4a^2, \therefore AC \cdot \delta AC + BD \cdot \delta BD = 0.$$

$$\therefore T' \cdot BD = T \cdot AC \text{ or } T' = T \cdot AC / BD.$$

Let  $BD$  make an angle  $\theta$  with the vertical. Then  $b = AC \cos \theta$  or  $AC = b \sec \theta$ ,  $BD = x(1 + T/\lambda) = x_1$ . Let  $R$ ,  $S$  be the reactions at  $A$ ,  $C$ . Revolving horizontally,  $R + S = 2T' \cos \theta$ . Revolving vertically,  $(R + S)p = 4w$ .

$$\therefore T' = \frac{2w}{p \cos \theta} = \frac{Tb \sec \theta}{x_1} \text{ or } T = \frac{2wx_1}{pb}.$$

$$\therefore x_1 = x \left( 1 + \frac{2wx_1}{pb\lambda} \right) \text{ or } x_1 = \frac{pb\lambda x}{pb\lambda - 2wx}.$$

$$x_1 = 2a \sin \frac{1}{2}A \text{ or } A = 2 \sin^{-1}(x_1/2a). \quad AB \text{ makes with the vertical an angle } \frac{1}{2}B + \theta = \frac{1}{2}\pi - \frac{1}{2}A + \theta.$$

162. Proposed by B. F. FINKEL, A. M., M. Sc., Professor of Mathematics and Physics, Drury College, Springfield, Mo.

Show that the velocity,  $v$ , of a wave along the surface of a liquid whose